

DETAILED ACTION

1. At Applicants' request, a telephonic interview was conducted on 09/24/2008, regarding the Office action dated 06/25/2008. In Applicants' Arguments / Remarks dated 09/24/2008, Applicant incorrectly states that, during that interview, the Examiner indicated that Applicants' arguments are correct. The Examiner's statements were pointedly non-conclusory and qualified by statements that the Examiner would adhere to appropriate procedural rules after the Examiner's receipt and analysis of the Applicants' Arguments / Remarks above, which are now considered in this Office action. No agreement otherwise was made in that telephonic interview.

Applicants' Arguments / Remarks are addressed in the Response to Arguments section below.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1, 6, 8 - 11, 24, 29, 31, 32, 34 - 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murai (US 6,705,708); Qui et al. (US 6,402,304); Cheng et al.: Thin Solid Films, Vol.385, Issues 1-2, April 2001, pp.5-10, Thickness-dependent microstructures and electrical properties of PZT films derived from sol-gel process; and Sumi et al.: Thin Solid Films, Vol.315, Issues 1-2, March 1998, pp.77-85: Effect of the

annealing temperature on structural and piezoelectric properties of the sol-gel Pb(Zr 0.56Ti 0.44) 0.90 (Mg 1/3 Nb 2/3) 0.10 O₃ films.

With respect to claim 1, Murai '708 teaches a **piezoelectric element** (Fig.6: 40) comprising a **first electrode film** (Fig.6: 33), a **layered piezoelectric film** (Fig.6: 43; col.8, lines 1-8) including a **first thin piezoelectric film** (Fig.6: 43a) provided on the **first electrode film** and a **second thin piezoelectric film** (col.8, lines 1-8) provided on the **first thin piezoelectric film** and a **second electrode film** (Fig.6: 44) provided on the **layered piezoelectric film**, wherein the **layered piezoelectric film** is made of **rhombohedral** (col.7, lines 17-20) or **tetragonal perovskite oxide** (col.5, lines 21-24) having **preferred orientation along the 111 plane** (col.8, lines 43-47), the **first and second thin piezoelectric films are aggregates of columnar grains** (the **first and second thin piezoelectric films are rhombohedral grains, which are columnar**), **respectively, which are continuously linked to each other** (col.8, lines 34-38, lines 48-52), **and the thickness of the layered piezoelectric film** (col.8, lines 8-9: disclosing layered piezoelectric film thickness of 1.5 microns).

However, Murai '708 does not teach **the ratio of the thickness of the layered piezoelectric film to the average cross-sectional diameter of the columnar grains of the second thin piezoelectric film is 20 to 60 inclusive**, and **the columnar grains of the second thin piezoelectric film have a larger average cross-sectional diameter than the columnar grains of the first thin piezoelectric film**.

Qui et al. teaches a piezoelectric film having PZT crystal with columnar grain diameter of 100 to 400 nm (col.11, lines 2-4). Cheng et al., Table 1: discloses PZT film thickness of 3300 nm. Sumi et al.: p.7, lines 14-17, discloses PZT grains 30 nm in diameter. These combined references teach a ratio of the thickness of the layered piezoelectric film to the average cross-sectional diameter of the columnar grains of the second thin piezoelectric film is 8.2 to 33 for 3300 nm film, and 50 to 133 for the 1500 film, inclusive, of which 20 to 60 is claimed (Qui et al.), and the columnar grains of the second thin piezoelectric film have a larger average cross-sectional diameter than the columnar grains of the first thin piezoelectric film (Cheng et al.; see Examiner's Response to Applicants' Argument c, dated 06/25/2008, page 22, for).

It would have been obvious to one of ordinary skill in the art at the time that this invention was made to modify Murai '708 to use PZT crystals with columnar grain diameter of 100 to 400 nm and film thicknesses of 1500 nm or 3300 nm, as taught by the combination of Qui et al., Cheng et al., and Sumi et al. references, such that the ratio of the thickness of the layered piezoelectric film to the average cross-sectional diameter of the columnar grains of the second thin piezoelectric film is 8.2 to 33 for 3300 nm film, and 50 to 133 for the 1500 nm film, and the columnar grains of the second thin piezoelectric film have a larger average cross-sectional diameter than the columnar grains of the first thin piezoelectric film, for the purpose reducing comparative grain size in order to improve bonding between films.

With respect to claim 6, the combination of Murai '708, Qiu et al., Cheng et al. and Sumi et al. references, as applied to claim 1, teaches a **piezoelectric element** (Murai '708: Fig.6: 40), **wherein the layered piezoelectric film** (Fig.6: 43; col.8, lines 1-8) **is made of lead zirconate titanate added with at least one of magnesium and manganese in an amount of more than 0 and not more than 10 mol%** (col.5, lines 22-26).

With respect to claim 8, the combination of Murai '708, Qiu et al., Cheng et al., and Sumi et al. references, as applied to claim 1, teaches an **inkjet head** (Murai '708: Fig.1:1) **comprising: a piezoelectric element** (Fig.6: 40) **including a first electrode film** (Fig.6: 33), **a layered piezoelectric film** (Fig.6: 43; col.8, lines 1-8) **including a first thin piezoelectric film** (Fig.6: 43a) **and a second thin piezoelectric film** (Fig.6: 43) **and a second electrode film** (Fig.6: 44) **stacked in this order; a diaphragm layer** (Fig.6: 30, 31, 32; col.2, lines 1-2) **disposed on the second electrode film side surface of the piezoelectric element** (Fig.6: 32; col.2, lines 8-11); **and a pressure chamber member** (Fig.6: 20) **including a pressure chamber** (Fig.6: 21) **for containing ink which is bonded to the surface of the diaphragm layer opposite to the second electrode film, such that the ink in the pressure chamber is discharged out by displacing the diaphragm layer in the thickness direction by the piezoelectric effect of the layered piezoelectric film** (col.3, lines 1-4).

With respect to claim 10, the combination of Murai '708, Qiu et al., Cheng et al., and Sumi et al. references, as applied to claim 8, teaches **an inkjet recording device** (Murai '708: Fig.1) **comprising an inkjet head** (Fig.1: 1) and a relative movement mechanism for relatively moving the inkjet head and a recording medium (Fig.1: 1, 4, 5, 6, 7), wherein recording is carried out by discharging the ink in the pressure chamber (Fig.6: 21) from a nozzle hole (Fig.4: 11) communicating with the pressure chamber onto the recording medium while the inkjet head and the recording medium are relatively moved by the relative movement mechanism.

With respect to claim 9, the combination of Murai '708, Qiu et al., Cheng et al., and Sumi et al. references, as applied to claim 1, teaches **an inkjet head** (Murai '708: Fig.1:1) **comprising: a piezoelectric element** (Fig.6: 40) **including a first electrode film** (Fig.6: 33), **a layered piezoelectric film** (Fig.6: 43; col.8, lines 1-8) **including a first thin piezoelectric film** (Fig.6: 43a) and **a second thin piezoelectric film** (Fig.6: 43) and **a second electrode film** (Fig.6: 44) **stacked in this order**; **a diaphragm layer** (Fig.6: 30, 31, 32; col.2, lines 1-2) **disposed on the first electrode film side surface of the piezoelectric element** (Fig.6: 31; col.2, lines 3-4); **and a pressure chamber member** (Fig.6: 20) **including a pressure chamber** (Fig.6: 21) **for containing ink which is bonded to the surface of the diaphragm layer opposite to the first electrode film**, such that the ink in the pressure chamber is discharged out by displacing the diaphragm layer in the thickness direction by the piezoelectric effect of the layered piezoelectric film (col.3, lines 1-4).

With respect to claim 11, the combination of Murai '708, Qiu et al., Cheng et al., and Sumi et al. references, as applied to claim 9, teaches **an inkjet recording device (Murai '708: Fig.1) comprising an inkjet head (Fig.1: 1) and a relative movement mechanism for relatively moving the inkjet head and a recording medium (Fig.1: 1, 4, 5, 6, 7), wherein recording is carried out by discharging the ink in the pressure chamber (Fig.6:21) from a nozzle hole (Fig.4: 11) communicating with the pressure chamber onto the recording medium while the inkjet head and the recording medium are relatively moved by the relative movement mechanism.**

With respect to claim 24, the combination of Murai '708, Qiu et al., Cheng et al., and Sumi et al. references, as applied to claim 1, teaches **a piezoelectric element (Murai '708: Fig.6: 40) further comprising an orientation control film disposed between the first electrode film (Fig.6: 33) and the first thin piezoelectric film (Fig.6: 43a), wherein the orientation control film is made of cubic or tetragonal perovskite oxide having preferred orientation along the 111 plane (col.12, lines 30-35).**

With respect to claim 29, the combination of Murai '708, Qiu et al., Cheng et al., and Sumi et al. references, as applied to claim 24, teaches **a piezoelectric element (Murai '708: Fig.6: 40), wherein the orientation control film is made of oxide based**

on perovskite lead lanthanum zirconate titanate and the degree of 111 crystal orientation of the orientation control film is 50% or more (col.12, lines 30-35).

With respect to claim 31, the combination of Murai '708, Qiu et al., Cheng et al., and Sumi et al. references, as applied to claim 24, teaches a piezoelectric element (Murai '708: Fig.6: 40), **wherein the orientation control film is made of lead lanthanum zirconate titanate added with at least one of magnesium and manganese in an amount of more than 0 and not more than 10 mol% (col.5, lines 22-26).**

With respect to claim 32, the combination of Murai '708, Qiu et al., Cheng et al., and Sumi et al. references, as applied to claim 24, teaches a piezoelectric element (Murai '708: Fig.6: 40), **wherein the layered piezoelectric film (Fig.6: 43; col.8, lines 1-8) is made of lead zirconate titanate added with at least one of magnesium and manganese in an amount of more than 0 and not more than 10 mol% (col.5, lines 22-26).**

With respect to claim 34, the combination of Murai '708, Qiu et al., Cheng et al., and Sumi et al. references, as applied to claim 24, teaches an inkjet head (Murai '708: Fig.1: 1) **comprising: a piezoelectric element (Fig.6: 40) including a first electrode film (Fig.6: 33), an orientation control film, a layered piezoelectric film (Fig.6: 43; col.8, lines 1-8) including a first thin piezoelectric film (Fig.6: 43a) and a second**

thin piezoelectric film (Fig.6: 43) and a second electrode film (Fig.6: 44) stacked in this order; a diaphragm layer disposed on the second electrode film side surface of the piezoelectric element; and a pressure chamber member (Fig.6: 20) including a pressure chamber (Fig.6: 21) for containing ink which is bonded to the surface of the diaphragm layer opposite to the second electrode film, such that the ink in the pressure chamber is discharged out by displacing the diaphragm layer in the thickness direction by the piezoelectric effect of the layered piezoelectric film (col.3, lines 1-4).

With respect to claim 35, the combination of Murai '708, Qiu et al., Cheng et al., and Sumi et al. references, as applied to claim 24, teaches **an inkjet head (Murai '708: Fig.1: 1) comprising: a piezoelectric element (Fig.6: 40) including a first electrode film (Fig.6: 33), an orientation control film, a layered piezoelectric film (Fig.6: 43; col.8, lines 1-8) including a first thin piezoelectric film (Fig.6: 43a) and a second thin piezoelectric film (Fig.6: 43) and a second electrode film (Fig.6: 44) stacked in this order; a diaphragm layer disposed on the first electrode film side surface of the piezoelectric element; and a pressure chamber member (Fig.6: 20) including a pressure chamber (Fig.6: 21) for containing ink which is bonded to the surface of the diaphragm layer opposite to the first electrode film, such that the ink in the pressure chamber is discharged out by displacing the diaphragm layer in the thickness direction by the piezoelectric effect of the layered piezoelectric film**

(col.3, lines 1-4).

With respect to claim 36, the combination of Murai '708, Qiu et al., Cheng et al., and Sumi et al. references, as applied to claim 34, teaches **an inkjet recording device (Murai '708: Fig.1) comprising an inkjet head (Fig.1: 1) and a relative movement mechanism for relatively moving the inkjet head and a recording medium (Fig.1: 1, 4, 5, 6, 7), wherein recording is carried out by discharging the ink in the pressure chamber (Fig.6: 21) from a nozzle hole (Fig.4: 11) communicating with the pressure chamber onto the recording medium while the inkjet head and the recording medium are relatively moved by the relative movement mechanism.**

With respect to claim 37, the combination of Murai '708, Qiu et al., Cheng et al., and Sumi et al. references, as applied to claim 35, teaches **an inkjet recording device (Murai '708: Fig.1) comprising an inkjet head (Fig.1: 1) and a relative movement mechanism for relatively moving the inkjet head and a recording medium (Fig.1: 1, 4, 5, 6, 7), wherein recording is carried out by discharging the ink in the pressure chamber (Fig.6: 21) from a nozzle hole (Fig.4: 11) communicating with the pressure chamber onto the recording medium while the inkjet head and the recording medium are relatively moved by the relative movement mechanism.**

4. Claims 2 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murai (US 6,705,708); Qiu et al. (US 6,402,304); Cheng et al.: Thin Solid Films,

Vol.385, Issues 1-2, April 2001, pp.5-10, Thickness-dependent microstructures and electrical properties of PZT films derived from sol-gel process; and Sumi et al.: Thin Solid Films, Vol.315, Issues 1-2, March 1998, pp.77-85: Effect of the annealing temperature on structural and piezoelectric properties of the sol-gel Pb(Zr 0.56Ti 0.44) 0.90 (Mg 1/3 Nb 2/3) 0.10 O₃ films; and further in view of Miyasaka (US 2002/0168831); and Barzegar: Study of Size (Aspect Ratio) Effect on Longitudinal Piezoelectric Coefficient Measured by Quasistatic Technique, 2002 IEEE Ultrasonics Symposium.

With respect to claim 2, the combination of Murai '708, Qiu et al., Cheng et al., Sumi et al. references teaches all the limitations of claim 2 except that **the columnar grains of the first thin piezoelectric film have an average cross-sectional diameter of 40 nm to 70 nm inclusive and a length of 5 nm to 100 nm inclusive.**

Miyasaka teaches that **the columnar grains of the first thin piezoelectric film have an average cross-sectional diameter of 40 nm to 70 nm inclusive** (Miyasaka: [0074]: disclosing columnar grain diameter of 50 nm in a film). Barzegar teaches **a length of 5 nm to 100 nm inclusive** (Barzegar: disclosing PZT crystal aspect ratio 0.1 to 2.0, for which a 50 nm diameter grain is $0.1 \times 50 = 5$ nm in length, and is $2.0 \times 50 = 100$ nm in length).

It would have been obvious to one of ordinary skill in the art at the time of this invention to modify the combination of Murai '708, Qiu et al., Cheng et al., and Sumi et al. references to provide that the columnar grains of the first thin piezoelectric film have an average cross-sectional diameter of 40 nm to 70 nm inclusive and a length of 5 nm

to 100 nm inclusive, as taught by the combination of Miyasaka and Barzegar references, for the purpose of reducing comparative grain size in order to improve bonding between films.

With respect to claim 25, the combination of Murai '708, Qiu et al., Cheng et al., Sumi et al., Miyasaka, and Barzegar references, as applied to claim 24, teaches all the limitations of claim 25 except **a piezoelectric element (Murai '708: Fig.6: 40) wherein the columnar grains of the first thin piezoelectric film (Fig.6: 43a) have an average cross-sectional diameter of 40 nm to 70 nm inclusive (Miyasaka: [0074]: disclosing columnar grain diameter of 50 nm in a film) and a length of 5 nm to 100 nm inclusive (Barzegar: disclosing PZT crystal aspect ratio 0.1 to 2.0, for which a 50 nm diameter grain is $0.1 \times 50 = 5$ nm in length, and is $2.0 \times 50 = 100$ nm in length).**

5. Claims 7 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murai (US 6,705,708); Qui et al. (US 6,402,304); Cheng et al.: Thin Solid Films, Vol.385, Issues 1-2, April 2001, pp.5-10, Thickness-dependent microstructures and electrical properties of PZT films derived from sol-gel process; and Sumi et al.: Thin Solid Films, Vol.315, Issues 1-2, March 1998, pp.77-85: Effect of the annealing temperature on structural and piezoelectric properties of the sol-gel Pb(Zr 0.56Ti 0.44) 0.90 (Mg 1/3 Nb 2/3) 0.10 O₃ films; and further in view of Takamatsu et al. (US 6,624,458).

With respect to claim 7, the combination of Murai '708, Qui et al., Cheng et al., and Sumi et al. references, as applied to claim 1, teaches that **the first electrode film is made of noble metal of Pt, Ir, Pd or Ru or an alloy containing the noble metal** (Murai '708: col.6, line 42). However, the combination of Murai '708, Qui et al., Cheng et al., and Sumi et al. references does not teach that the first electrode film is an **aggregate of columnar grains having an average cross-sectional diameter of 20 nm to 30 nm inclusive.**

Takamatsu et al. teaches that the first electrode film is an aggregate of columnar grains having an average cross-sectional diameter of 20 nm to 30 nm inclusive. (Takamatsu et al.: col.7: lines 29-31: disclosing IrOx with columnar grains of 20 to 50 nm diameter).

It would have been obvious to one of ordinary skill in the art at the time of this invention to modify the combination of Murai '708, Qui et al., Cheng et al., and Sumi et al. references, as taught by Takamatsu et al., so that the first electrode film is an aggregate of columnar grains having an average cross-sectional diameter of 20 nm to 30 nm inclusive in order to achieve improved inter-film adhesion.

With respect to claim 33, the combination of Murai '708, Qiu et al., Cheng et al., Sumi et al., and Takamatsu et al. references, as applied to claim 24, teaches a **piezoelectric element** (Murai '708: Fig.6: 40), **wherein the first electrode film** (Fig.6: 33) **is made of noble metal of Pt, Ir, Pd or Ru or an alloy containing the noble metal** (col.6, line 42) **and is an aggregate of columnar grains having an average**

cross-sectional diameter of 20 nm to 30 nm inclusive (Takamatsu et al.: col.7: lines 29-31: disclosing IrO_x with columnar grains of 20 to 50 nm diameter).

6. Claims 3 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murai (US 6,705,708); Qui et al. (US 6,402,304); Cheng et al.: Thin Solid Films, Vol.385, Issues 1-2, April 2001, pp.5-10, Thickness-dependent microstructures and electrical properties of PZT films derived from sol-gel process; and Sumi et al.: Thin Solid Films, Vol.315, Issues 1-2, March 1998, pp.77-85: Effect of the annealing temperature on structural and piezoelectric properties of the sol-gel Pb(Zr 0.56Ti 0.44) 0.90 (Mg 1/3 Nb 2/3) 0.10 O₃ films, in view of Takamatsu et al. (US 6,624,458).

With respect to claim 3, the combination of Murai '708, Qui et al., Cheng et al, and Sumi et al. references, as applied to claim 1, teaches a **piezoelectric element** (Murai '708: Fig.6: 40), **wherein the columnar grains of the second thin piezoelectric film** (Fig.6: 43a, 43) **have an average cross-sectional diameter of 60 nm to 200 nm inclusive** (Qui et al.: Abstract, lines 9-12: disclosing PZT columnar grain diameter range of 100 nm to 15,000 nm) **and a length of 2500 nm to 5000 nm inclusive** (Abstract, lines 9-12).

With respect to claim 26, the combination of Murai '708, Qiu et al., Cheng et al., and Sumi et al. references teaches all the limitations of claim 26, as discussed in the

103 rejection of claim 3. Therefore claim 26 is rejected for the same reasons.

7. Claims 4, 5, 27, 28, and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Murai (US 6,705,708); Qui et al. (US 6,402,304); Cheng et al.: Thin Solid Films, Vol.385, Issues 1-2, April 2001, pp.5-10, Thickness-dependent microstructures and electrical properties of PZT films derived from sol-gel process; and Sumi et al.: Thin Solid Films, Vol.315, Issues 1-2, March 1998, pp.77-85: Effect of the annealing temperature on structural and piezoelectric properties of the sol-gel Pb(Zr 0.56Ti 0.44) 0.90 (Mg 1/3 Nb 2/3) 0.10 O3 films, and further in view of Takamatsu et al. (US 6,624,458), Murai (US 6,494,567), and Murai (US 7,083,269).

With respect to claim 4, the combination of Murai '708, Qui et al., Cheng et al., and Sumi et al. references teaches all the limitations of claim 1, discussed above.

However, the combination of Murai '708, Qui et al., Cheng et al., and Sumi et al. references does not teach a **piezoelectric element according to claim 1, wherein the first and second thin piezoelectric films are made of oxide based on perovskite lead zirconate titanate, the degree of 111 crystal orientation of the first thin piezoelectric film is 50 % to 80 % inclusive and the degree of 111 crystal orientation of the second thin piezoelectric film is 95 % to 100 % inclusive.**

Murai '567 teaches a **piezoelectric element according to claim 1, wherein the first and second thin piezoelectric films are made of oxide based on perovskite lead zirconate titanate, the degree of 111 crystal orientation of the first thin**

piezoelectric film is 50 % to 80 % inclusive (Murai, '567: Abstract: lines 5-9, disclosing orientation of 100 face at 40 - 70%, 110 face at 10%, therefore 11 face is at 50 - 70%). Murai '269 teaches that **the degree of 111 crystal orientation of the second thin piezoelectric film is 95 % to 100 % inclusive** (Murai, '269: col.2, lines 1-5: disclosing thin film orientation in the 111 plane of 90% or more).

It would have been obvious to one of ordinary skill in the art at the time that this invention was made to modify the combination of Murai '708, Qui et al., Cheng et al., and Sumi et al. references to provide that the first and second thin piezoelectric films are made of oxide based on perovskite lead zirconate titanate, the degree of 111 crystal orientation of the first thin piezoelectric film is 50 % to 70 % inclusive, as taught by Murai '567, and the degree of 111 crystal orientation of the second thin piezoelectric film is 95 % to 100 % inclusive, as taught by Murai '269, in order to achieve improved crystallinity (Murai '567: Abstract, lines 10-13).

With respect to claim 5, the combination of Murai '708, Qui et al., Cheng et al., Sumi et al., Takamatsu et al., Murai '567, and Murai '269 teaches **a piezoelectric element** (Murai '708: Fig.6: 40) **according to claim 1, wherein the chemical composition ratio of the layered piezoelectric film** (Fig.6: 43; col.8, lines 1-8) **is represented as**

$$[\text{Pb}] : [\text{Zr}] : [\text{Ti}] = (l + a) : b : (1 - b),$$

the first and second thin piezoelectric films (Fig.6: 43a, 43) **have the same value b of 0.40 to 0.60 inclusive, the first thin piezoelectric film has a larger Pb content**

than the second thin piezoelectric film (Takamatsu et al.: col.14, lines 32-34), **the first thin piezoelectric film** (Murai, '708: Fig.6: 43a) **has the value a of 0.05 to 0.15 inclusive and the second thin piezoelectric film has the value a of 0 to 0.10 inclusive** (Murai '269: col.4, lines 58-63).

With respect to claim 27, the combination of Murai '708, Qui et al., Cheng et al., Sumi et al., Takamatsu et al., Murai '567, and Murai '269 teaches **a piezoelectric element** (Murai '708: Fig.6: 40), **wherein the first and second thin piezoelectric films** (Fig.6: 43a, 43) **are made of oxide based on perovskite lead zirconate titanate, the degree of 111 crystal orientation of the first thin piezoelectric film is 50 % to 80 % inclusive** (Murai, '567: Abstract: disclosing orientation of 100 face at 40 – 70%, 110 face at 10%, therefore 11 face is at 50 – 70%) **and the degree of 111 crystal orientation of the second thin piezoelectric film is 95 % to 100 % inclusive** (Murai, '269: col.2, lines 1-5: disclosing thin film orientation in the 111 plane of 90% or more).

With respect to claim 28, the combination of Murai '708, Qui et al., Cheng et al., Sumi et al., Takamatsu et al., Murai '567, and Murai '269 teaches **a piezoelectric element** (Murai '708: Fig.6: 40), **wherein the chemical composition ratio of the layered piezoelectric film** (Fig.6: 43; col.8, lines 1-8) **is represented as**

$$[\text{Pb}] : [\text{Zr}] : [\text{Ti}] = (1 + a) : b : (1 - b),$$

the first and second thin piezoelectric films (Fig.6: 43a, 43) **have the same value b of 0.40 to 0.60 inclusive, the first thin piezoelectric film has a larger Pb**

content than the second thin piezoelectric film (Takamatsu et al.: col.14, lines 32-34), the first thin piezoelectric film has the value a of 0.05 to 0.15 inclusive and the second thin piezoelectric film has the value a of 0 to 0.10 inclusive (Murai '269: col.4, lines 58-63).

With respect to claim 30, the combination of Murai '708, Qui et al., Cheng et al., Sumi et al., Takamatsu et al., Murai '567, and Murai '269 references teaches a piezoelectric element (Murai '708: Fig.6: 40), wherein the chemical composition ratio of the orientation control film is represented as [Pb] : [La] : [Zr] : [Ti] = x times (1-z) : z : y : (1 - y), the value x is 1.0 to 1.20 inclusive, the value y is 0 to 0.20 inclusive and the value z is more than 0 and not more than 0.30 (Murai '269: col.4, lines 58-63).

Response to Arguments

8. Applicants' arguments filed 09/24/2008 have been fully considered but they are not persuasive.

(a) Applicant argues that the outstanding Office Action alleges at page 3, lines 5-8, that Murai '708 teaches "the columnar grains of the second thin piezoelectric film have a larger average cross-sectional diameter than the columnar grains of the first thin piezoelectric film (col. 8, lines 21-23)." However, as Applicant discussed in response to the previous rejections, Murai '708 merely describes in col. 8, lines 21-23, "the total thickness of the second piezoelectric layer (i.e., the piezoelectric film 43 formed on the part from which the bottom electrode 33a was removed) is greater than the thickness of the first piezoelectric layer (i.e., the piezoelectric film 43 formed on the other part)." Therefore, Murai '708 fails to teach or suggest that "the columnar grains of the second thin piezoelectric film have a larger average cross-sectional diameter than the columnar grains of the first thin piezoelectric film" as recited in the pending

claims. Moreover, the Examiner concedes this point in the Office Action at page 20, line 11, to page 21, line 4.

Examiner responds to Applicants' argument (a) by noting that Murai '708 deficiency was overcome by Cheng et al.: Thin Solid Films, Vol.385, Issues 1-2, April 2001, pp.5-10, Thickness-dependent microstructures and electrical properties of PZT films derived from sol-gel process; and Sumi et al.: Thin Solid Films, Vol.315, Issues 1-2, March 1998, pp.77-85: Effect of the annealing temperature on structural and piezoelectric properties of the sol-gel Pb(Zr 0.56Ti 0.44) 0.90 (Mg 1/3 Nb 2/3) 0.10 O₃ films. Applicants had been advised of this new ground for rejection in the Office action dated 06/25/2008, at Examiner's response to Applicants' argument b, on page 21.

(b) Applicant argues that the Examiner relies upon Qui, Cheng and Sumi to teach the ratio of the thickness of piezoelectric film to the average cross-sectional diameter of the columnar grains of the second piezoelectric film. Without conceding this assertion or the merits of combining these references with Murai '708, applicant points out that neither of these references cure the deficiency of Murai as noted above. In other words, neither Qui, Cheng, nor Sumi teach or suggest that "the columnar grains of the second thin piezoelectric film have a larger average cross-sectional diameter than the columnar grains of the first thin piezoelectric film" as recited in the pending claims.

Examiner responds to Applicants' argument (b) by noting that Applicants' arguments fail to comply with 37 CFR 1.111(b) because they amount to a general allegation that the claims define a patentable invention without specifically pointing out how the language of the claims patentably distinguishes them from the references. Applicants' arguments do not comply with 37 CFR 1.111(c) because they do not clearly point out the patentable novelty which he or she thinks the claims present in view of the state of the art disclosed by the references cited or the objections made. Further, they do not show how the amendments avoid such references or objections.

Conclusion

9. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ALEXANDER C. WITKOWSKI whose telephone number is (571) 270-3795. The examiner can normally be reached on Monday - Friday 8:00 AM to 5:00 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen D. Meier can be reached on 571-272-2149. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/ACW/

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